Use of Surgical Facemasks in the Operation Theatre : Effective or Habit?

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Introduction

In the era of cost constraints, shrinking hospital budgets and evidence-based medicine, many health-care professionals have begun re-examining traditional infection control practices. There has been much debate about whether the wearing of surgical facemasks (SFM) in the operation theatre (OT), distinct from respiratory protective devices (RPDs), is an effective practice to prevent surgical site infections (SSI) or is just a habit that has no basis in fact.

SFM vs. RPDs

RPDs are masks which are certified as personal protective equipments (PPE) under the European Directive 89/686/EEC (PPE Regulation 2002 SI 2002 No. 1144). These provide a high level of filtering capability and face-fit and are recommended particularly for people in the healthcare sector dealing with symptomatic patients where aerosols are likely to be generated (e.g. at times of influenza epidemic) [1].

Face masks, on the other hand, can be labelled as surgical, laser, isolation, dental or medical procedure masks. SFMs are plain masks that cover the nose and mouth and are held in place by fabric ties or with elastic straps around the ears. These are available in two configurations, molded cup shape with an elastic cord around the head and non-molded which may be further available as a pleated or a flat-paper shield with two ties or ear loops. There may or may not be a flexible nose bridge. Furthermore, pleats can be either two ply or three ply. General purpose SFMs are usually two ply, designed mainly to capture respiratory secretions (including bacteria and viruses) in exhaled breath rather than to protect operators from airborne infections. These are not designed to prevent inhalation of airborne particles and their ability to prevent disease acquisition

varies. The three ply SFMs usually have > 99% bacterial filtration efficacy and are one step short of respirators on this account [2].

Specifications of SFMs

The material used by disposable SFMs has to be adequate to hold back air-borne contaminants which include, but are not limited to, biological contaminants, such as bacteria, viruses, fungal spores, lint, mineral fines, dust, skin squames and respiratory droplets expelled from the mouth and nose. It also should minimize condensation of moisture within the mask. Specifications developed by the American Society of Testing and Materials (ASTM) are generally accepted as the industry standard and include the following:

- Bacterial Filtration Efficiency (BFE)* which specifies the percentage of 3.0 microns sized aerosols containing *Staphylococcus aureus* sized 0.8 microns which are filtered out.
- Particulate Filtration Efficiency* which specifies the percentage of aerosols of particle size 0.1-5.0 microns which are filtered out.
- 'Separating' *Efficiency* tested for both solid (sodium chloride) and liquid particles (paraffin oil) which is denoted by either of the two letters, 'P' or 'N'. Swedish and European standards (SS-EN) use the letter 'P' - P3 separating 99.95% and P2 94.0% of both solid particles and oil mist. American standards use the designation 'N' which indicates that these have not been tested for liquid particles - N95 is presumed to separate 95% of solid particles only.

Collectively, these three tests measure the filtering capacity for bacteria, viruses and other sub-micron particles [3].

Other tests which have a bearing on the acceptability

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of SFMs include the *Pressure Differential* (Delta-P) which measures the air flow resistance of masks and is an objective measure of 'breathability'. A Delta-P over 5.0 is uncomfortable for general use, whereas a mask with a Delta-P under 2.0 allows air movement across but is less effective. The *Fluid Resistance* (FR) reflects the mask's ability to transfer fluids from the outer layers to the inner layer as the result of a splash or spray. ASTM specifies testing with synthetic blood at pressures of 80, 120 or 160 mm of Hg to qualify for low, medium or high fluid resistance [2,4].

The general recommended wearing time for an ASTM-certified SFM is four hours [2]. SFMs become less effective over time. A fresh face mask almost completely prevented bacterial contamination of an agar plate 30 cms from the mouth, but after 15 minutes there was a measurable increase in the level of contamination [6]. This time is further reduced if SFMs are poorly fitted, placed below the nose or wet with blood or body fluids [3].

Disposable SFMs can inherently contribute to contamination of the surgical wound by increasing OT germ concentration and wound contamination by 'venting' (air leaks from the side of the mask due to insufficient tension on the strings) and 'wicking' (conveying liquid, via capillary action, from behind the mask). In addition, skin scales also frequently rub off the face due to friction ('wiggling'). The quantity of germ concentration is altered by both facial hair and recent shaving [1,3].

SFMs however, do protect the wearer from splashes. Masks with face shields and/or protective eyewear are recommended whenever splash, spray or aerosol of blood or other potentially infectious materials may be generated [5,7]. When SFMs were placed on the patients' mouths while undergoing surgery, a lower incidence of SSI have been variously reported. However, this practice is disadvantageous for patients undergoing regional anaesthesia where deficient assessment of lip cyanosis, anxiety, retention of carbon-dioxide and increase in cost restricts the use. It may also be difficult to obtain a good fit with SFMs with an endotracheal tube *in situ* [8]. Eitherway, during general anaesthesia, higher airborne germ concentration has been detected but this has been attributed to higher activity and number of staff involved causing more air turbulence.

A recent Cochrane review did not report any difference in SSI rates on wearing SFMs or not, whether disposable or cloth. But the limited number of trials in the review makes it unsafe to draw definitive conclusions [4]. It is very difficult to perform controlled research on the effects of wearing surgical masks on wound

infections as investigators may be hesitant due to the potential harm to patients if a mask is not worn.

Centre for disease control (CDC) guidelines for isolation precaution in hospitals recommend the concomitant use of a mask and respirator as a two tier precaution to help prevent two way transmission of infections between patients and staff in the OT from both recognized and unrecognized sources [9]. There is little evidence however that the current generation synthetic SFMs, when used alone, protect the staff either from airborne bacteria or Hepatitis B virus or reduce SSI [2,7].

Current recommendations

While guideline for prevention of surgical site infection (1999) [10], strongly recommended the use of SFMs for prevention of SSI, the 2007 CDC guideline [9] reiterated the use of different qualities of SFMs for sterile procedures and otherwise without adding any new scientific data for support of the recommendation. Most international guidelines acknowledge the controversy surrounding the use of disposable SFMs [2,7,9] with no clear clinical and experiential evidence that wearing SFMs may decrease the incidence of SSI, which itself depends on several variables, especially patient's immunological status and behavior of the surgical team in the operating field. SFMs with 95% BFE are efficient microbial barriers up to wearing time (4 hours) and therefore, should be made mandatory in the following circumstances:

- Within 3 m of the sterile zone (Putsep Zone I), particularly when the face is in close proximity to the operative field and/or the need for speaking is anticipated.
- If the patient has risk factors for a blood borne infection [1,2].
- By anaesthesiologists when carrying out sterile procedures under full aseptic conditions [8,9].
- While carrying out procedures that generate splashes or sprays of blood, body fluids, secretions, or excretions (e.g. endotracheal suctioning, bronchoscopy, invasive vascular procedures etc).

SFMs should also be standard wear for patients. Non-scrubbed staff need not wear SFMs in OTs with forced ventilation [1,2,4].

Correct technique for use of SFMs

These should cover both the nose and mouth completely, assuring no tenting at the sides to allow dispersion of microbes. A mask should never be allowed to hang or dangle around the neck, nor should it be folded and placed in a pocket for later use. Masks should be

either on or off. If the mask cannot be easily re-adjusted or becomes wet by overt breathing or fluid insult, it should be replaced immediately as the filtration efficiency and protective ability of SFMs is compromised when the mask becomes wet, torn or dislodged. Removal of the mask by grasping the filter-section (pleats) could result in contamination of the wearer's hands. Disposal is recommended by handling the tapes only [2,5,10].

Recommendations for procurements

Three ply SFMs with a small pliable strip at the nose area should be preferred. The mask material should have high separating/filtering efficiency (>99% and N95) with a Delta-P between 2.0-5.0 and a medium-high FR. Masks with different fluid resistant properties can be procured as per risk of exposure to blood, body fluids, excretions and other potential hazards as well as degree of sterility and isolation required.

All health care workers must be aware of the potential risk of exposure as well as protective capabilities of the mask being worn.

Conflicts of Interest

None identified

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